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Canadian Science Advisory Secretariat
Maritimes Region | Science Response 2017/021

STOCK STATUS UPDATE OF ATLANTIC HALIBUT ON THE SCOTIAN SHELF AND SOUTHERN GRAND BANKS (NAFO DIVS. 3NOPs4VWX5Zc)

Context

Atlantic Halibut (*Hippoglossus hippoglossus*) is the largest of the flatfishes and ranges widely over Canada's East Coast. The management unit definition (3NOPs4VWX5Zc) is based largely on tagging results which indicate that Atlantic Halibut move extensively throughout the Canadian North Atlantic with smaller fish moving further than larger fish.

The Atlantic Halibut fishery was unregulated until a Total Allowable Catch (TAC) was implemented in 1988 and a legal size limit (≥81 cm total length) was established in 1994. The Fisheries and Oceans Canada (DFO) Research Vessel (RV) survey provides an index of abundance for incoming recruitment. An Industry-DFO Longline Halibut Survey (Halibut Survey) on the Scotian Shelf and southern Grand Banks (3NOPs4VWX5Zc) was initiated in 1998 to provide an index of exploitable (≥81 cm total length) Atlantic Halibut on the Scotian Shelf and southern Grand Banks. A new assessment model and assessment procedures were adopted in November 2014 (Cox et al. 2016) to inform Fisheries and Aquaculture Management (FAM) of the status of the Halibut resource and to provide harvest level advice based on standardized catch rates from the Halibut Survey and stratified mean numbers-per-tow from the DFO Summer RV survey (4VWX). Science advice provided in December 2014 and 2015 used this new procedure (DFO 2015, 2017).

FAM asked Science to update and evaluate abundance indicators, landings and fishing mortality estimated from tagging data. This response provides 2017-2018 TAC advice based on the Objectives and Harvest Strategy adopted at the Scotia-Fundy Groundfish Advisory Committee (SFGAC) meeting in March 2015.

This Science Response Report results from the Science Response Process of December 1, 2016, on the Stock Status Update of 3NOPs4VWX5 Atlantic Halibut.

Background

Biology

Atlantic Halibut are most abundant at depths of 200-500 m in the deep-water channels running between the banks and along the edge of the continental shelf, with larger individuals moving into deeper water in winter. The geographic range of Atlantic Halibut in the Northwest Atlantic extends from the coast of Virginia in the south to the waters off northern Greenland.

Female Atlantic Halibut grow faster than the males and attain a much larger maximum size. Atlantic Halibut grow rapidly (approximately 10 cm per year) until the age of maturity, which for this region is estimated to be at 77 cm for males (Age 5-6) and 119 cm for females (Age 9-10).

Description of the Fishery

The management unit definition (3NOPs4VWX5Zc, Figure 1) was based largely on tagging results that indicated that Atlantic Halibut move extensively throughout the Canadian North Atlantic. Within the management unit, Atlantic Halibut is fished mostly along the edges of the continental shelf and mainly by longline. Until 1988, the fishery was unregulated. A TAC of 3,200 metric tonnes (mt) was first established in 1988 and was reduced to a low of 850 mt in 1995, in response to an 8 year decline in landings. Since 1994, management plans and licence conditions require the release of Atlantic Halibut less than 81 cm. Beginning in 1999, the TAC has been increased several times and was set at 3,149 mt in 2016 (Table 1; Figure 2).

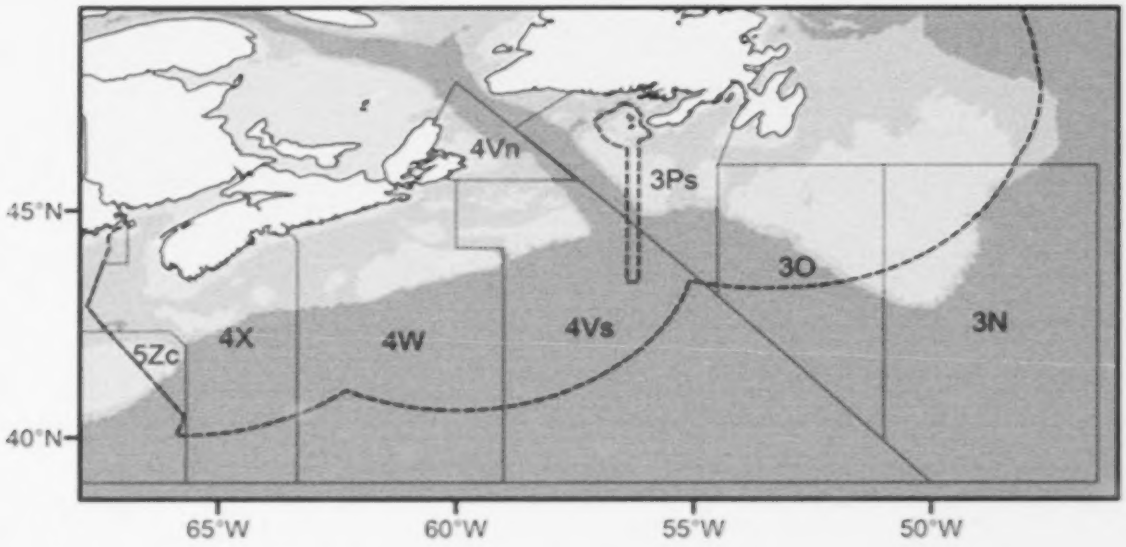

Figure 1. Management unit 3NOPs4VWX5Zc.

The Northwest Atlantic Fisheries Organization (NAFO) statistics are used to describe removals up to 2015, because landings occur in two DFO regions (Maritimes Region and Newfoundland and Labrador Region) and outside Canada's Exclusive Economic Zone (EEZ), as well as from other countries including Portugal, Spain, France, and the US. Only the Canadian landings are reported for 2016. Most of the Halibut landed are caught on the Scotian Shelf (4VWX). In 2015, landings reported in NAFO's STATLANT 21 database (NAFO Table 21A) decreased slightly on the southern Grand Banks (3NOPs) and increased in 4VWX (Table 1). Of the 1,047 mt of landings reported for 3NOPs in 2015, 349 mt were landed by countries other than Canada, which is up from 119 mt foreign landings in in 3NOPs in 2013, and 240 mt in 2014. In some years, Canadian quota carry forward provisions and foreign catches result in landings above the TAC.

Table 1. Total reported Canadian and foreign landings (metric tonnes) of Atlantic Halibut from Northwest Atlantic Fisheries Organization (NAFO) divisions 3NOPs4VWX5Zc[1]. Ten-year annual average landings are presented for 1960 to 2009.

		Landings			Landings[3]	Canadian TAC[4]
	Year(s)	3NOPs	4VWX	5Zc[2]	3NOPs4VWX5Zc	3NOPs4VWX5Zc
Decadal Average	1960-69	996	1464	-	2460	-
Decadal Average	1970-79	487	851	-	1338	-
Decadal Average	1980-89	955	1561	50	2566	-
Decadal Average	1990-99	503	790	30	1323	1855
Decadal Average	2000-09	607	863	15	1484	1318
Annual	2010	556	1279	11	1853	1850
Annual	2011	475	1322	19	1822	1850
Annual	2012	643	1460	29	2135	2128
Annual	2013	681	1799	33	2518	2447
Annual	2014	1079	1775	20	2885	2563
Annual	2015	1047	2146	22	3224	2738
Annual	2016[5]	264	1883	27	2174	3149

[1] Landings 1960-2015 from NAFO Table 21A as of December 19, 2016.
[2] Landings were first listed in 5Zc in 1986.
[3] NAFO Table 21A reported by calendar year.
[4] Total Allowable Catch (TAC) set for April-March fishing year for Canadian commercial fishery. Prior to 1988 the Atlantic Halibut catch was unregulated.
[5] Landings for 2016 are preliminary, from the Maritimes Fisheries Information System (MARFIS) as of November 18, 2016.

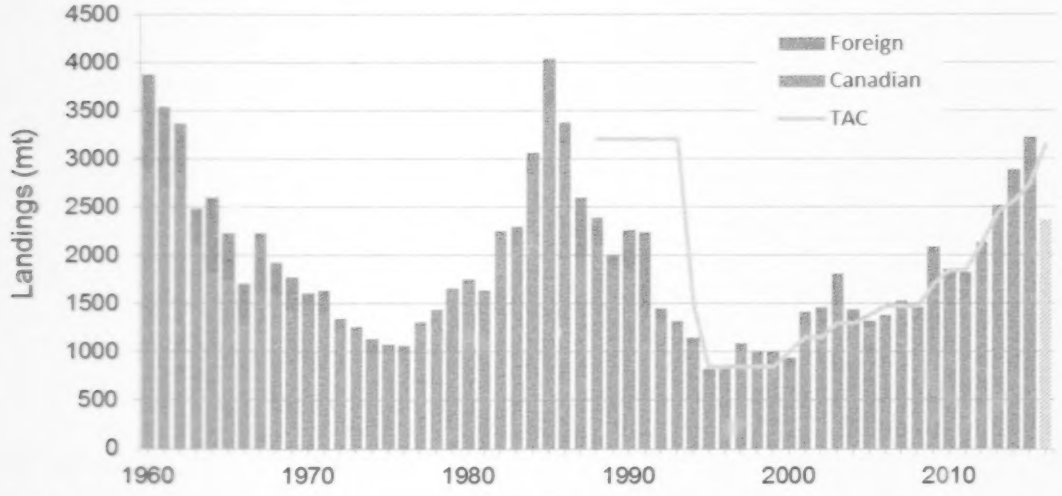

Figure 2. Northwest Atlantic Fisheries Organization (NAFO) reported Canadian (blue) and foreign (red) landings (metric tonnes) for 3NOPs4VWX5Zc Atlantic Halibut. The 2016 landings (hashed bar) are incomplete. The solid green line is the Canadian Total Allowable Catch (TAC). NAFO Table 21A reported by calendar year and the TAC is set for April-March.

Assessment Framework

A new assessment framework was adopted in November 2014 (Cox et al. 2016). This framework used a new statistical catch-at-length (SCAL) model to assess the stock status and an operating model (HAL) to evaluate the impact of a suite of harvest strategies on the biomass/population trends and landings. In March 2016, the SFGAC adopted an F=0.14 harvest strategy with a cap on annual changes in TAC of 15%. Stock status in interim years is assessed based on the Halibut Survey index of exploitable biomass and the DFO Summer RV (4VWX) survey survey. If the DFO Summer RV (4VWX) survey index falls below the long-term mean in 3 of the most recent 5 years, a framework assessment could be triggered. Science advice on TAC is based on the 3-year mean Halibut Survey index of exploitable biomass.

Analysis and Response

4VWX Research Vessel Survey

The DFO Summer RV survey (4VWX) has been conducted every July since 1970. The median size of Halibut caught in the trawl survey is between 40 and 50 cm. The catch of Atlantic Halibut in this survey increased between 2000 and 2011 (Figure 3). Since 2011, catch rates have remained above the long-term mean, with 2016 the fifth highestyear in the time series.

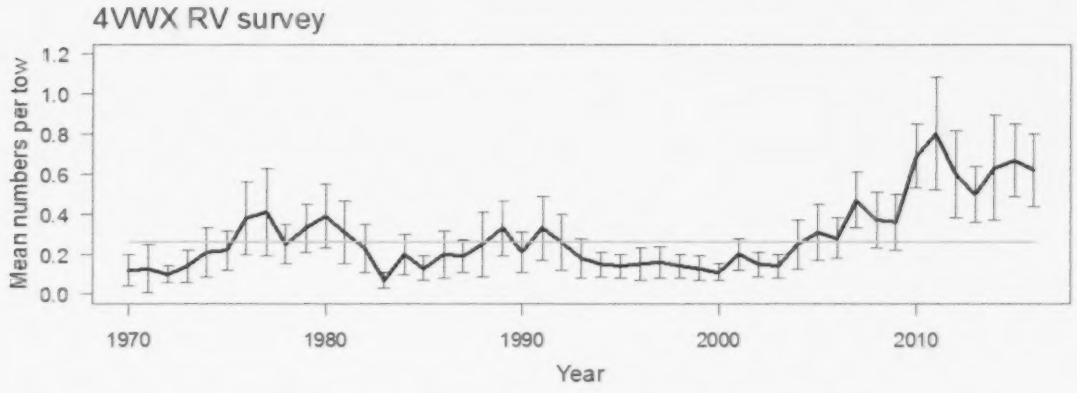

Figure 3. Plot of stratified mean number of halibut per tow for DFO Summer Research Vessel survey sets in 4VWX from 1970 to 2016. The grey horizontal line is the long-term (1970-2015) mean (mean=0.28 per tow). The vertical bars indicate 95% confidence intervals.

Halibut Survey

The Halibut Survey provides an index of abundance of Atlantic Halibut ranging in size between 50 and 220 cm (den Heyer et al. 2015). The survey is completed by commercial fishermen with onboard observers between May and August. Halibut Survey catch rates were standardized using a Generalized Linear Model (GLM) including both station and year effects. The catch rate has increased since 2004, with the 2016 standardized catch rate from the GLM being the second highest in the 19-year time series (Figure 4 and 5). The 2016 index of exploitable biomass from the halibut survey is 8% higher than 2015, and 35% higher than 2014, the last year the stock was assessed.

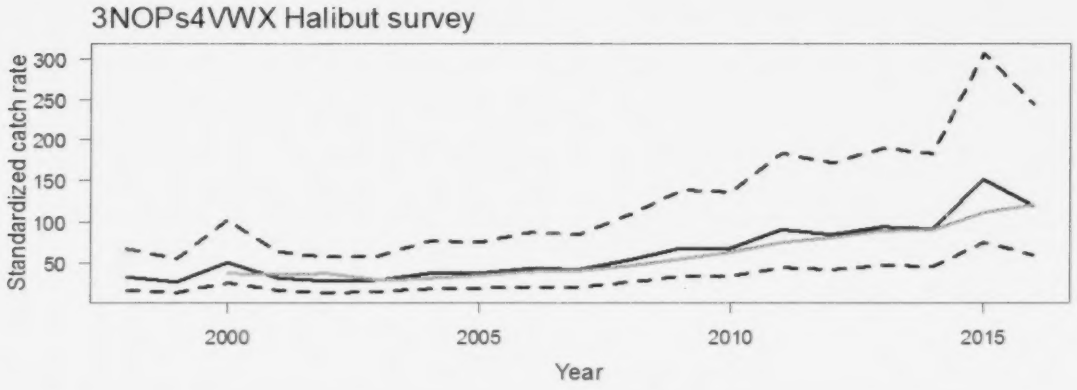

Figure 4. Plot of standardized catch rate (kg/1000 hooks/10 hrs) from Generalized Linear Mean of 3NOPs4VWX Halibut Survey fixed stations completed in 5 or more years since the beginning of the survey. The solid black line is predicted catch rate; the dash lines indicate 95% confidence interval. The 3-year mean of the index (solid red line) is also plotted.

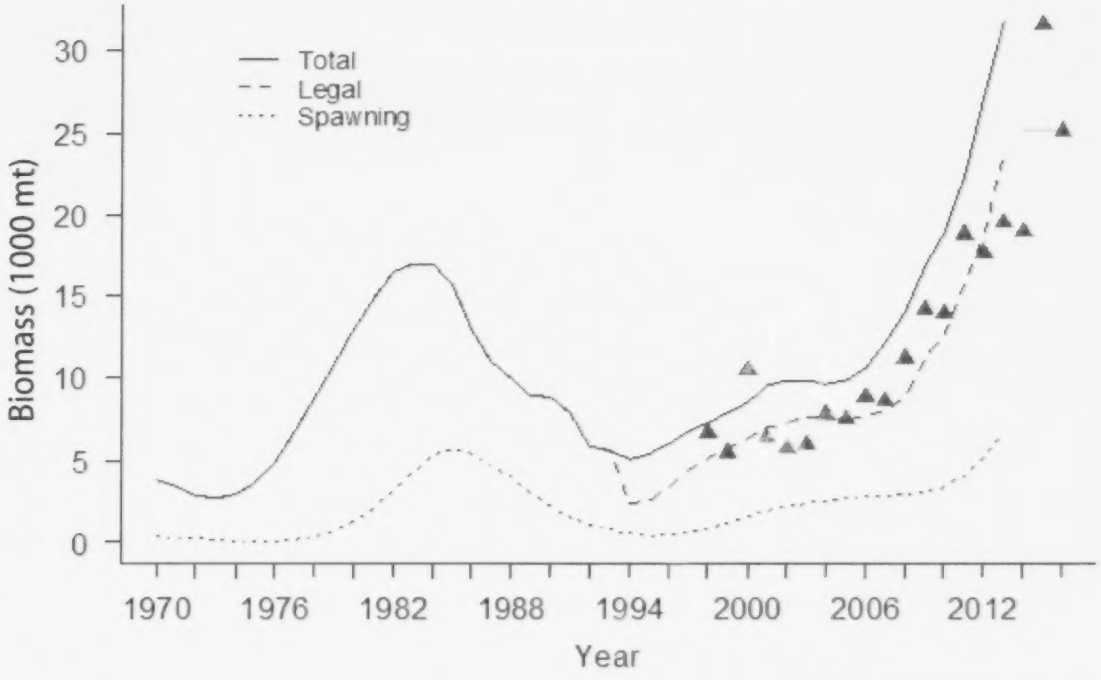

Figure 5. Plot of Halibut biomass estimated between 1970 and 2013 from the stock assessment model (black lines) and the Halibut Survey (blue triangles). The solid line is total biomass, the dashed line is legal biomass, and the dotted line is spawning stock biomass. The solid grey bar is the 3-year mean of the Halibut Survey biomass index.

Harvest Control Rule

Applying the F=0.14 strategy with a maximum change of 15% from the 2016 TAC (3,149 mt) results in an increase in the 2017-2018 TAC to 3,621 mt, which is an increase of 15%. This application of the harvest control rule, and the projections from the HAL model (DFO 2015), assume all removals from Canadian and international fisheries are included.

Multi-year Mark-recapture Tagging Model

In 2006, DFO and the Atlantic Halibut Council (AHC) began the Halibut All Sizes Tagging (HAST) program to estimate population size, exploitation rate and evaluate the distribution of Atlantic Halibut within the Scotian Shelf southern Grand Banks management unit (den Heyer et al. 2015). As of October 11, 2016, of the 4,146 Atlantic Halibut that were double tagged with t-bar anchor tags between 2006 and 2014, 778 were recaptured with sufficient information to be used in the multi-year mark-recapture model. Assuming 80% tag reporting and 100% survival from tagging, fishing mortality (F) is declining from a high of 0.15 in 2009 to a low of 0.06 in 2015 (Figure 6). The absolute estimates of F from the tagging model are not directly comparable to the assessment model, but trends are the same as the assessment model. The HAST program provides an independent indicator of trend in fishing mortality.

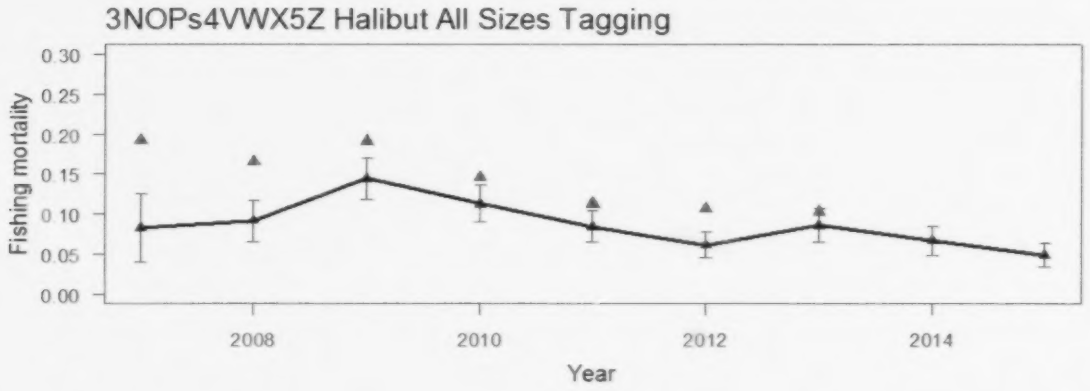

Figure 6. Plot of instantaneous fishing mortality estimated from the multi-year tagging model (solid black line) and the assessment model (blue triangles). The vertical bars indicate 95% confidence intervals.

Conclusions

The 3NOPs4VWX5Zc Atlantic Halibut stock has a history of overfishing that predates the time series used in the stock assessment model (i.e. prior to 1970). The assessment model indicates that the stock has increased from the depleted state observed in the early 1990s. The updated DFO Summer RV (4VWX) survey and the 3NOPs4VWX5Zc Halibut Survey indices show that abundance of both pre-recruits and recruits continue to be high. The 2016 DFO Summer RV (4VWX) index remains above the long-term mean and suggests that the fishery will continue to benefit from high recruitment in the next couple of years. The index of exploitable (greater than 81 cm) Atlantic Halibut biomass is the second highest in the 19 year time series. Further, fishing mortality, estimated from the multi-year mark-recapture model, continues to decline.

The 3-year mean index of exploitable biomass is 8% higher than last year and 35% higher than 2014. A TAC of 3,621 mt in 2017 is an increase of 472 mt (15%), and is consistent with the Harvest Strategy adopted by the SFGAC.

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